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ABSTRACT

This study investigates the impact of a field-based methods course on the reality of teaching experienced by preservice biology teachers. Four questions guided the research: (1) What are the perceptions of the preservice teachers about biology teaching? (2) What are the preconceptions of preservice teachers about high school students? (3) What constructivist teaching practices were used by preservice teachers? and (4) What evidence of reflective thinking was explained in the journals of the preservice teachers? This qualitative study was conducted with 33 students enrolled in Biology Methods, which is a required course in the Biology Teacher Licensure program. The results of the study were encouraging, especially the finding that constructivist teaching practices can be gradually included in the teaching repertory of beginning teachers through constant practice as they develop an understanding of the teaching-learning process. The preservice teachers unanimously agreed that field experience is an effective method to understand the reality of the teaching profession. Preservice teachers are immersed in teaching situations during field experience. In order to achieve the objectives of field experience, the mentor or cooperating teacher and the university instructor/supervisor must work together as a team. They should agree on the field experience objectives, expectations, and the methods of monitoring a student's progress. (CCM)

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Bringing the Reality of Science Teaching by Using a Field-Based Methods Course

by
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BRINGING THE REALITY OF SCIENCE TEACHING BY USING A FIELD-BASED METHODS COURSE

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Field Experience in Science Methods Courses

Science methods courses for the elementary and secondary teacher education programs require the application of science concepts that support the curriculum, provide clinical experiences that demonstrate skills in classroom management of inquiry lessons, and opportunities to model effective teaching strategies and techniques to motivate and involve students in building concepts about science. It is possible that preservice teachers enrolled in a science methods course may experience for the first time the complexity of the teaching-learning process and realize that learning how to teach is a continuous process of self-development, regulation, and transformation. Another important event that occurs in a science methods course with field experience is the application of pedagogical theories and principles into practice in the classroom.

George J. Posner (1992) said that the one indispensable part of any teacher preparation program is field experience. The purposes of field experience are to provide preservice teachers with the opportunity to observe the dynamics of student-teacher interaction during a teaching episode, help them formulate a model of good teaching, become aware of students' characteristics, experience teaching, develop methods of assessing students' learning formally and informally, and begin to reflect about the teaching-learning process. It is during the field experience that the integration of theory into practice becomes evident to the preservice teachers.

Preservice teachers are immersed in teaching situations during field experience. Mentors or cooperating teachers are generally involved to monitor the progress of students in acquiring sound teaching practices. To achieve the objectives of the field experience the mentor or cooperating teacher and the university instructor/supervisor must work together as a team. They should agree on the field experience objectives, expectations, and the methods of monitoring

students' progress.

This paper presents the field experience component of a Biology Methods course in the biology teacher licensure program at a southeastern university.

The Field Experience in the Biology Methods course

The field experience for the Biology Methods course is designed to apply previously learned knowledge in biology and teaching strategies and to learn and grow from the experience of working with a mentor and students in the school environment. As preservice teachers spend time in the classroom interacting with the mentor and the students, they will be guided to become "reflective teachers who review, reconstruct, reenact, and critically analyze their own and their students' performance, and who formulate explanations with evidence" (Shulman, 1987).

The Research Questions

The following questions guided this investigation on the impact of a field-based methods course on the reality of teaching experienced by preservice biology teachers.

1. What are the perceptions of the preservice teachers about biology teaching?
2. What are the preconceptions of preservice teachers about high school students?
3. What constructivist teaching practices were used by preservice teachers?
4. What evidence of reflective thinking was explained in the journals of the preservice teachers?

Methods

This qualitative study was conducted with 33 students enrolled in Biology Methods course which is required in the Biology Teacher Licensure program. The course adopted the philosophy of teaching biology as inquiry and constructivism as the instructional model from the Biological Sciences Curriculum Study Developing Biological Literacy (Uno, 1993). Instructional methods such as guided discovery, learning cycle, model building, role playing, simulations, and the use of discrepant events were practiced in cooperative learning groups during the course. Therefore, the preservice biology teachers played the role of students and experienced the activities to help build concepts.

Instruments Used

Two instruments from the Expert Science Teaching Educational Evaluation Model (ESTEEM) were used (Burry-Stock, 1995). The ESTEEM Science Classroom Observation Rubric was used to evaluate the teaching practices from actual performance and videotaped teaching. The ESTEEM Student Outcome Assessment Rubric was administered to the students after the lesson to measure the quality of teaching by preservice teachers such as in communicating the main idea, piquing students' curiosity, and explaining the relevance of the lesson. Three qualified evaluators rated the videotape of the preservice teachers on the Science Classroom Observation Rubric to assess their teaching practices and scored the students' responses on the Student Outcome Assessment Rubric.

Besides these instruments, other data sources provided by the preservice teachers include a 2 to 3-page statement of their philosophy of teaching, self-critique report on their teaching based on the videotape, and journal entries in the professional portfolio. The mentors' evaluation and anecdotal reports were also used. The professional portfolio and self-critique were examined to show the development of preservice biology teachers into becoming a reflective teacher.

Preparation for the Field Experience

Several procedures to achieve the objectives of the field experience were followed. First, the course instructor and the staff of the Office of Field Experience selected mentors from public schools within commuting distance from the university. These mentors are master biology teachers qualified to serve as models in teaching. Second, the course instructor matched the preservice biology teachers' schedule with the class schedule of the mentors. Third, an orientation meeting with the mentors and the instructor was held to discuss the goals and objectives of the field experience and the tasks and expectations from the preservice teachers. In addition, the ESTEEM Science Classroom Observation Rubric was introduced to the mentors. They practiced rating with the instrument using videotaped teaching episodes. Evaluation protocols for mentors to assess the performance of preservice teachers on various tasks were also discussed.

The Tasks Performed by the Preservice Teachers During the Field Experience

The reports on the tasks listed below were compiled and presented in a field experience portfolio. It was evaluated by the instructor based on completeness, organization, neat presentation, and evidence of reflection and transformation in their teaching practices.

The five tasks completed by the preservice biology teachers were:

TASK 1. Observation of the school campus, facilities and resources.

The observations included a description of the geographic location of the school, the community around the school, the layout of the buildings, the ambience of the main office, the athletic field and office, the academic areas of the campus, the cafeteria, and the auditorium or multi-purpose room. The library and its holdings were surveyed for up-to-date books, audiovisual resources, and multimedia instructional materials, with attention to science learning resources. The computer lab (if there is a separate room) was included in the survey. Greenhouse and nature trail used for instruction were also noted.

The classroom of the mentors was also observed with attention to the resources for science teaching. Books, references, and magazines, posters, bulletin board displays, animals in cages, terraria, potted plants, and other instructional aides were noted. Safety facilities and equipment such as eyewash, shower, blanket, and fire extinguisher were described when present.

The report for this task included photographs of some areas of the campus, a copy of the school handbook which describes the policy of the school, a copy of the curriculum guide in biology, a map of the school campus, and a floor plan of the biology classroom.

TASK 2. Observing a biology teaching event.

An observation form developed by the instructor was used. The observation focused on the administrative routines, instructional procedures such as motivational techniques, teaching methods and strategies, student activities, evaluation of student learning, closure of the lesson, and classroom management and discipline performed by the mentors.

TASK 3. Helping the mentor to prepare a laboratory or class activity.

This task illustrated the importance of planning a lesson. Preservice biology teachers worked

closely with their respective mentor in preparing the laboratory or class activity, such as, gathering the materials and supplies for the number of groups of students per class, and preparing reagents and solutions. Tasks 3 and 4 were done sequentially. Preservice teachers helped their mentors to teach the lesson for which they prepared the classroom and laboratory setups. They saw how the students used the materials and setups, and they developed ideas to improve the laboratory management. Besides preparing instructional materials, they also learned the seating plan and workstations of groups of students. They called the class roll to become acquainted with the students.

The report for this task included the responses to questions that required preservice teachers to reflect on the practical importance of what they learned in their biology and chemistry laboratory courses, the various preparations required for the types of activities used to teach the lesson, the amount of time involved in the preparation of a laboratory or classroom activity.

TASK 4. Helping the mentor to teach a laboratory or class activity.

During this activity the preservice biology teachers helped in various ways, such as, tutoring groups of students, supervising students during a laboratory activity, and guiding students in conducting an experiment or project. In some lessons, the mentors have the preservice biology teachers grade laboratory reports so they become aware of students' quality of work and to match these with their expectations.

The report for this task consisted of journal entries for at least three lessons where they prepared the materials and setups for the laboratory or class activities and helped teach them. They described their participation in teaching the lesson, the students' activity, and their perception of themselves as they helped students. Questions in the journal entry required them to reflect on their teaching ability, their perceptions about high school students, and ways to improve if they have to teach the lesson again.

TASK 5. Teaching two biology lessons.

Planning for this task was started early in the second week of the field experience when the mentors decided what lessons will be taught by their assigned preservice teacher. This

sequential teaching allowed them to teach a concept completely. As early as possible they submitted a draft of their lesson plans to their mentor and instructor. The mentors and instructor asked questions, evaluated the accuracy of the concept(s), and gave suggestions and management tips for the lessons. The instructor observed and videotaped the first teaching episode. Then, the preservice teachers critiqued their videotape using the reflective questions such as "What was your strength in teaching this lesson?", " What would you consider as your weakness?", and " Write a plan to improve two weaknesses in your next day of teaching." The mentors gave feedback which preservice teachers considered in improving their second teaching experience.

Results

The findings on this qualitative study were based on the data sources and instruments used during the field experience. The answers to the research questions are summarized.

Perceptions about Biology Teaching and Adolescent Learners

The preservice teachers philosophy of teaching revealed preconceptions about the nature of biology, the teaching process, and the characteristics of adolescent learners. The following statements summarized the preservice teachers' perceptions of biology teaching.

1. All students can learn biology by using different teaching strategies to match their learning styles. They also learn at varying rates---some learn certain concepts faster or slower than others.
2. Biology education should teach the concepts and processes that are relevant to living in the real world. Biology teaching should present ample examples from experiences of students in the natural world.
3. One important function of biology teaching is to teach students to think analytically.
4. Biology learning should involve active learning with fun and exciting activities appropriate for the cognitive level of students.
5. Finally, biology teachers should respect and make students feel that they sincerely care about them.

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The preconceptions of preservice biology teachers about adolescents were generally positive. Most of them believed that Grade 10 students are already mature and they understand what and why they are doing something. In addition, preservice biology teachers assumed that high school students are motivated, enthusiastic to learn, and possess the basic skills to read and understand their textbooks.

Teaching Practices of Preservice Teachers

The ESTEEM Science Classroom Observation Rubric was used to assess if the preservice biology teachers use constructivist teaching methods learned in the course. The Biology Methods course emphasizes the constructivist teaching model through inquiry or investigative laboratory, problem-solving lessons, the use of the learning cycle, discrepant event, metaphors and analogies, simulations, role playing, and model building. In following the constructivist model of teaching, students redefine, reorganize, elaborate, and change their initial concepts through interaction with their environment, including other individuals (Uno, 1993). The instrument consists of four categories exemplifying constructivist instruction, namely:

Category 1: Facilitating the Learning Process. The teacher is a facilitator of the learning process. The responsibility for learning is on the student.

Category 2: Content Specific Pedagogy. The teacher is constantly making the content of the lesson relevant to student understanding.

Category 3: Contextual Knowledge. The teacher shows a high level of proficiency in using contextual knowledge during the lesson.

Category 4: Content Knowledge. The teacher displays excellent knowledge of the subject matter.

The mentors and three qualified evaluators, with an inter-rater reliability of 0.87, examined the teaching practices of preservice biology teachers. The average percent score of the preservice teachers on the four categories were: Category 1= 78, Category 2= 81, Category 3= 72, and Category 4= 84. The average total percent score on all categories based on the total percent scores of 33 preservice biology teachers was 80. These averages suggest that preservice

biology teachers when provided with adequate instruction and practice, can begin to teach using constructivist methods. Although the majority of the scores were only 70-80 percent, these results were encouraging for beginning teachers. The results indicate that preservice teachers need to improve their teaching skills in categories 1 and 3. Category 1 defines the teachers' role in a constructivist classroom. A high score in this category would show the students have control and responsibility for their own learning. Understandably, beginning teachers were not comfortable with this practice because they were afraid of losing control of the class. Category 3 requires preservice teachers to confront students with their misconception and guide them in resolving it. Few beginning teachers have developed the fluid control of digressing from the lesson plan and confronting students' misconceptions. Most beginning teachers have a tunnel view of their teaching, therefore, unexpected responses that need clarification generally went unnoticed or were ignored. The average percent score on categories 2 and 4, both referring to content (biology) teaching showed that the preservice teachers have sound knowledge of biology and were able to explain the concepts accurately. Table 1 presents the average scores (expressed in %) of 33 preservice teachers at four levels of performance based on the scores at the 90 %, 80%, 70%, and 60% levels.

Table 1
Sum of Percent Scores of 33 Preservice Teachers at Four Levels of Performance

Sum of Percent Score at	Category 1	Category 2	Category 3	Category 4
90% level	364	362	341	370
80% level	1180	1207	1045	1215
70% level	800	849	745	890
60% level	236	264	260	315
Average Percent Score	78.18	81.27	72.45	84.54

The frequency distribution of the total scores of preservice teachers is shown in Table 2. The

highest total percent score was 91 and the lowest was 62. Preservice teachers who scored in the 90 percent level were students with high grades in biology and professional studies courses. They showed an easy predisposition to teaching and ability to weave and tailor the explanation to the students' language and comprehension. However, those who were in the 60 percent level need to improve in understanding the content and in communicating concepts accurately. The constructivist teaching practices most commonly used by the preservice teachers were inquiry laboratory investigations, the learning cycle, model building, and simulations.

Table 2
Frequency Distribution of Total Scores in the Science Classroom Observation Rubric

Total Score Based on Percentage Level	Number of sample and % of total (N=33)
100-90 (highest score=91)	4 (12%)
89-80	14 (42%)
79-70	11 (33%)
69-60	4 (12%)

Seven hundred twenty students expressed their perceptions of the teaching performance of the preservice teachers in their responses to three questions on the Student Outcome Assessment Rubric. On the question, "What was the main idea of the lesson?", 62 % of the responses stated the main idea of the lesson without elaboration. The statements given by the students were book-related or from notes copied during the lesson. Of 62%, approximately 25% gave responses that stated the main idea with details, descriptions, and accurate elaborations. These responses showed that the students understood the concept(s) and can express related ideas in their own words. The students' responses to this question correlate to Category 1 of the Science Classroom Observation Rubric. This means that students who can state the main idea accurately with elaborations in their own words have conceptual understanding as well as taking responsibility for their own learning. The second question, " List some questions that today's

lesson made you want to ask?", revealed that 55 % of the students asked questions related to the lesson. Of the 55% who asked questions, only 20% asked abstract questions. Some of these questions where complex and multifaceted. Several questions were of the "what if" or "how do we know" kind of questions. These types of questions are divergent and evaluative in contrast to the concrete and convergent questions asked by 35% of the students. Finally, the question on relevance revealed how students perceived the lessons' importance in their life. Only 22% of the students stated in detail that the lesson is important to some aspect of society. This was observed mostly in lessons on human genetics, pollution, and endangered species. Forty percent of the responses stated that the lesson was relevant to their life. These responses revealed that students have a narrow view of biological principles as it affects biodiversity, medical technology, and the future of the living world. The two questions on inquiry and relevancy are correlated to Categories 2 and 4 of the Science Classroom Observation Rubric which deal with pedagogy related to student understanding and knowledge of subject matter. This means that when teachers focus on conceptual understanding, relating concepts to their students' daily lives, and providing a learning environment where students can work with one another or in groups, students have the opportunity to develop critical thinking and independently formulate relationships among concepts they learned. Only a few of the students (2% of approximately 720) had no response on one or two of the questions. There was no observable pattern in the responses of students in the classes of preservice teachers who scored in the 90 percent and those who scored in the 60 percent level of the ESTEEM Science Classroom Observation Rubric.

Becoming a Reflective Teacher

During the field experience, preservice teachers have extensive contact with their mentors, the university instructor, and the students in the assigned classes. They received plenty of feedback, both formal and informal, throughout the field experience which helped develop their perceptions of themselves as a teacher. To document their reflection about these feedback the preservice teachers kept a journal. A summary of the reflections of preservice teachers after the

field experience follows.

1. On Biology Teaching. The preservice biology teachers observed that students participated in cooperative group activities. They also found that lessons emphasizing relevance to themselves and to society proved interesting to high school students. Lectures laden with technical terms and scientific language turned off students' interest in biology.

2. About Adolescent Learners. Many preservice teachers confessed their disappointment about the lack of maturity and initiative of students to learn for the sake of knowledge. They also expressed the incongruity between their expectation of the students' ability and what most students' displayed in their work. All of the preservice teachers agreed that discipline and classroom management is an area of difficulty where they need help.

3. On Mentors and Mentoring. The preservice biology teachers expressed gratitude for the time, guidance, and professional help that mentors extended to them. The unanimous description of the mentors by the preservice biology teachers was "The mentors were sincere in nurturing beginning teachers like us." Through mentoring, preservice teachers were initiated to engage in discussing professional growth, to receive feedback and suggestions about their teaching and related behavior. The mentoring approach helped them build their self-concept as a teacher. On the other hand, the mentors appreciated the opportunity to help prepare future biology teachers. The experience provided them the opportunity to reflect on their early development as a teacher. All mentors agreed that mentoring was a rewarding experience.

4. On the Professional Portfolio. At the beginning of the field experience, most of the preservice teachers were not convinced about the value of the portfolio. They questioned why they have to compile items for the portfolio (artifacts) then write perceptions about them. The portfolio, in their mind, was just another exercise on paper and busy work. However, they confessed that as they wrote their daily journal and described the artifacts they realized the wholeness and richness of their experience. While reflecting on their experiences in the classroom, they expressed that they feel their passage from student to professional teacher. The reflections also helped them evaluate their decisions and actions related to instruction and

interactions with students.

5. *On the Field Experience.* The preservice teachers unanimously agreed that the field experience is an effective method to understand the reality of the profession called teaching. No amount of classroom book learning would come close to the richness of the field experience.

Conclusions

For many years microteaching and peer teaching have been used in methods courses. More recently, field-based methods courses are becoming popular. It is apparent that field experience provides meaning to the complex interplay of coursework and practical classroom experience. Ebenezer and Connor (1998) pointed out that learning how to teach science is developmental-- aided by constant reflection of the preservice biology teachers' knowledge of science content, ability to deliver the content in the best method possible, and the concern about the impact of the teacher to the learner. Field experience provides the venue for developing effective biology teachers.

Mentoring by master biology teachers during the field experience provides professional support for preservice biology teachers while practicing their teaching skills to high school students during the field experience. Through the watchful eyes of the mentors, preservice biology teachers have the opportunity to change their own and their students' behavior. Through constant discussion and reflection about practical knowledge in teaching between mentors and preservice biology teachers, they developed professional collegiality. According to Mason (1989), the involvement of the science educator, science teachers, and the preservice science teacher is a cooperative and collaborative effort representing the university and the local schools in the preparation of science teachers.

The results of the study are encouraging especially the finding that constructivist teaching practices can be gradually included in the teaching repertory of beginning teachers through constant practice as they develop an understanding of the teaching-learning process. Becoming a reflective teacher is also a gradual process that a field-based methods course could effectively

develop.

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